**RELATED RATES OF CHANGE WHERE MORE THAN 2 RATES OF CHANGE ARE INVOLVED**

We can use the Chain Rule { } to relate three rates of change.

**Example**: A cylindrical water tank with a diameter of 5m is being filled with water at a rate of 0.18 m3/h. After hours the curved surface area of the water in the tank was

A m2, the height of water in the tank was metres and the volume was V m3. Find the rate at which A is increasing when the height is 2.5m.

* Find:
* Use Chain Rule: and then we will need to expand this Chain Rule.
* We have been given = 0.18 m3/h, so the Chain Rule now looks

like: .

* To find , if we do not have an expression for V in terms of A or A in terms of V to be able to differentiate, then we can find by applying the Chain Rule again:

.

* Both A and V can be expressed in terms of , so the missing variable in our Chain Rule is : .
* We will now combine the two chain rules: and
* The expression for can now be written as: .
* Since A = , then . Since V = , and .
* = x x 0.18.
* Since the radius is 2.5, then = x x 0.18 = 0.144 m2/h.













